Static Computer Memory Integrity Testing (SCMIT)

An experiment flown on STS-40 and STS-87 as part of GAS Payloads G-616 and G-036

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Tom Hancock AverStar
thomas.hancock@hsv.boeing.com
tom.hancock@msfc.nasa.gov

Background

- The Static Computer Memory Integrity Testing (SCMIT) experiment was first flown during the STS-40 mission in June 1991 and later during the STS-87 mission in December 1997

Background

- SCMIT is designed to detect soft-event upsets in passive magnetic memory
- A soft-event upset is a change in the logic state of active or passive forms of magnetic memory, commonly referred to as a “Bitflip”
- A soft-event upset can cause software exceptions, unexpected events, start spacecraft safeing or corrupt fault protection and error recovery capabilities

Background

- In its most sever form loss of mission or spacecraft can occur

Scientific Objectives

- The scientific objectives of this experiment are:
  - Observe Soft-event upsets
  - Determine the frequency of soft-event upsets
  - Determine the characteristics of soft-event upsets
  - Determine the possible effectiveness of different types of shielding material

- During STS-40:
  Evaluate the possibility of using static memory as a type of passive detectors

Experiment - General

- The experiment uses a number of commercial floppy disks
- Each disk was loaded with a text file/bit-map identical in size and format
- Each disk contained one large text file/bitmap

Experiment STS-40

- Ten floppy disks were inserted into each of four storage containers

- Several of the disks were covered in one of three types of shielding material:
  - Normal anti-static nylon
  - Aluminized Mylar mesh
  - Field dispersing (electrically neutral) nylon

Experiment STS-87

- Five floppy disks were inserted into a one storage container
- Three disks were covered with one of the three types of shielding material used during STS-40

Procedure - General

The experiment was constructed by:

- Developing a standard text file/bitmap
- Copying an identical standard text file/bitmap on each disk
- Testing to assure the integrity of each text file/bitmap

Procedure - General

- Covering a number of the disk with one of the three types of shielding material
- Inserting disks into storage containers
- Integrating the disks and storage containers into the GAS canister

Procedure STS-40

- The experiment was integrated into the GAS canister in June of 1990
- The experiment remained on the GAS Bridge assembly until after landing in June 1991
- The experiment was on orbit for 9 days
- Post flight recovery and analysis took place within 30 days of landing

Procedure STS-87

- The experiment was on orbit for 16 days
- Floppy disks that had not shown any affects (no evidence of soft-event upsets, text file/bitmap intact) from the STS-40 flight were re-flown during STS-87
- Post flight recovery and analysis took place within 60 days of landing

Post Flight Analysis - General

- After each flight every disk was analyzed for evidence of soft-event upsets
- Each text file bit was viewed/compared and verified

Post Flight Analysis STS-40

- During the first flight, single event, soft event upsets were not observed

- However ten disks in one of the four storage containers did exhibit characteristics that could be attributed to a massive number of soft-event upsets

- Preflight testing was conducted that verified the integrity of each text file/bitmap before integration and launch

Post Flight Analysis STS-40

- Preflight tests should have captured the types of errors discovered if the errors occurred during development and construction

- The disks that exhibited these characteristics where not shield during the flight

- It is important to note the experiment was stored for one year on the GAS Bridge assembly prior to launch in June 1991

Post Flight Analysts STS-87

- During the second flight, single event, soft event upsets were not observed.

- The massive errors observed in 10 disks from the first flight were not present in any shielded or unshielded disk re-flown during STS-87

Conclusions - General

- The data supports an anomalous event occurring to10 disks flown on STS-40
- Additional exposure (16 days on orbit) on STS-87 of five disks did not reproduce the types of errors observed during STS-40
- Storage of the experiment on the GAS Bridge for one year prior to the launch of STS-40 may have contributed to the observed errors

Conclusions - General

- The third flight on STS-??? will repeat the experiment has flown during STS-87

Conclusions - STS-40

- The types of soft-event upsets anticipated prior to flight were not observed
- A massive number of changes were observed in the logic state of 10 disks from a single container
- This indicates the possibility that soft-event upsets or a similar type of event occurred to 25% of the samples flown

Conclusions - STS-40

- Possible while the experiment was stored on the GAS Bridge (1 year prior to flight) it was exposed to a magnet field or high-energy event

- However it is worth noting 30 other disks divided among 3 different containers did not show any affect from the flight

- It is also possible the errors occurred during construction of the experiment. However this is considered unlikely

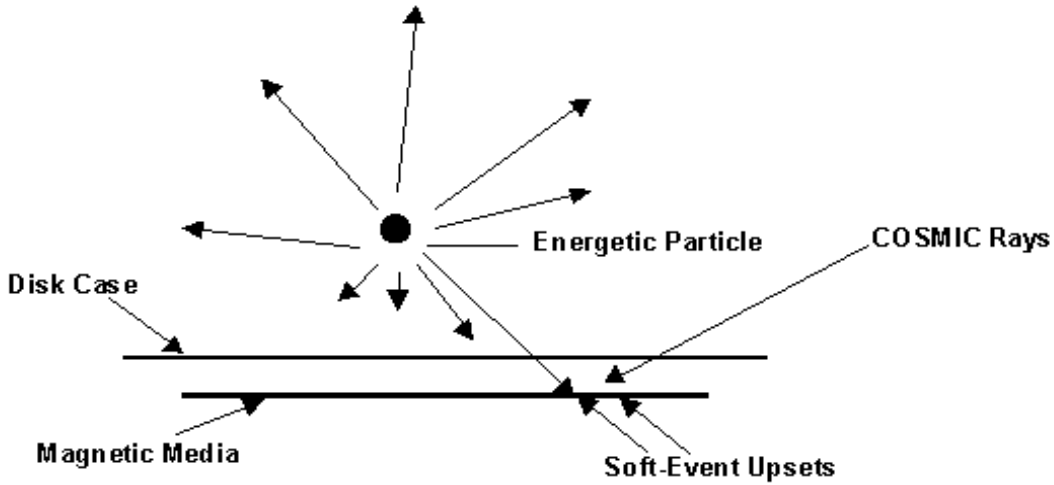
Conclusions - STS-87

- During the second flight exposure to the environment of low earth orbit increased to 16 days
- A smaller number of disks served as detectors and all five were contained in a single box
- Three of the five disks were covered by one of the three types of shielding material

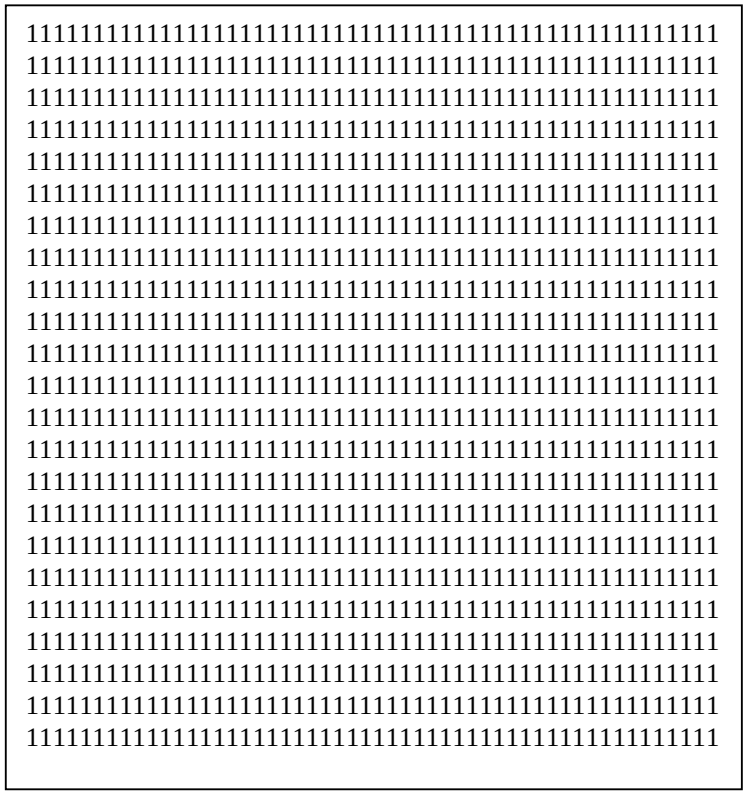
Conclusions - STS-87

- Soft-event upsets were not observed in any disk
- In addition the type of massive errors from the first flight were not observed
- This data is contra to the first flight
- The third flight on STS-101 will repeat the experiment has flown during STS-87

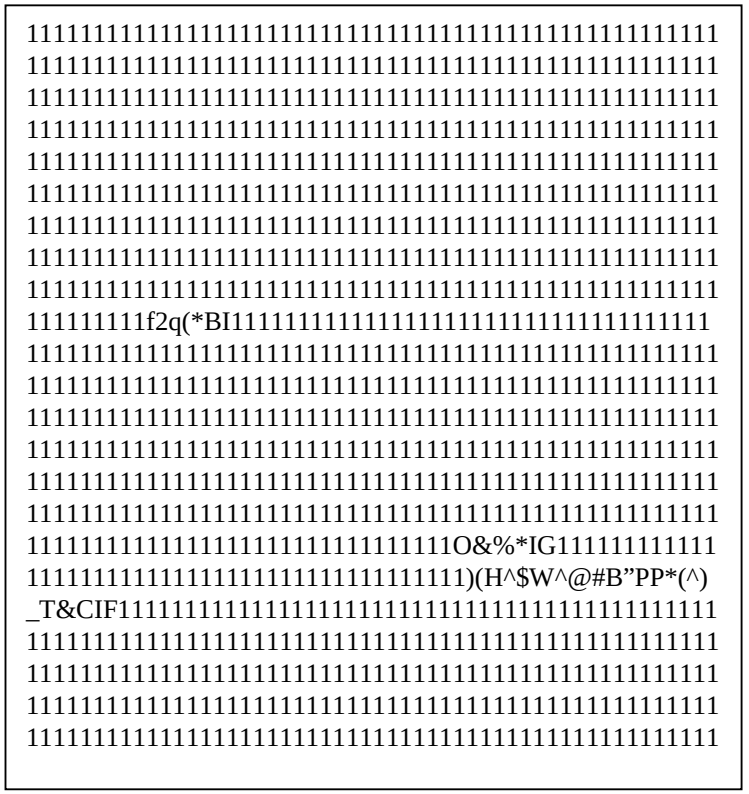
Soft-Event Upsets



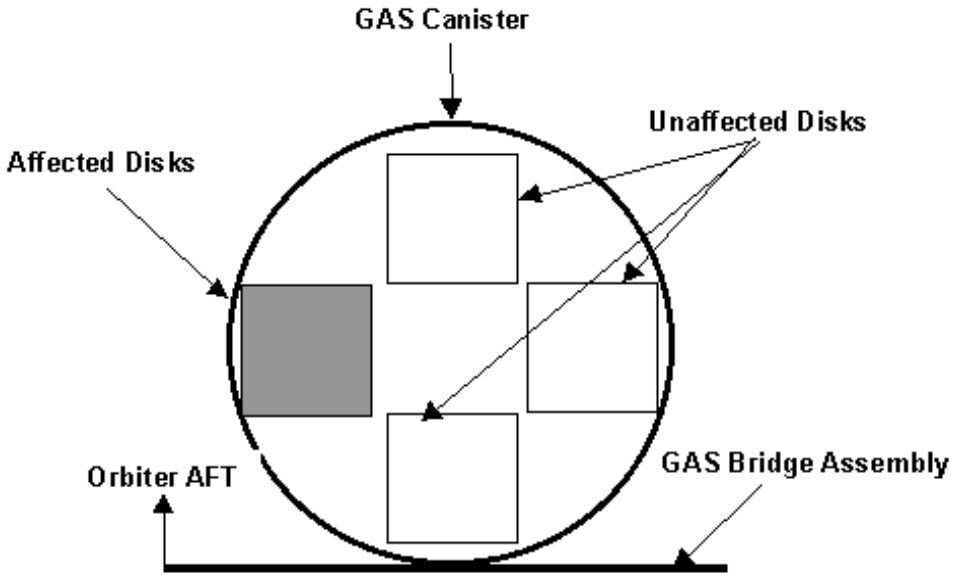
Uncorrupted Text File/Bitmaps



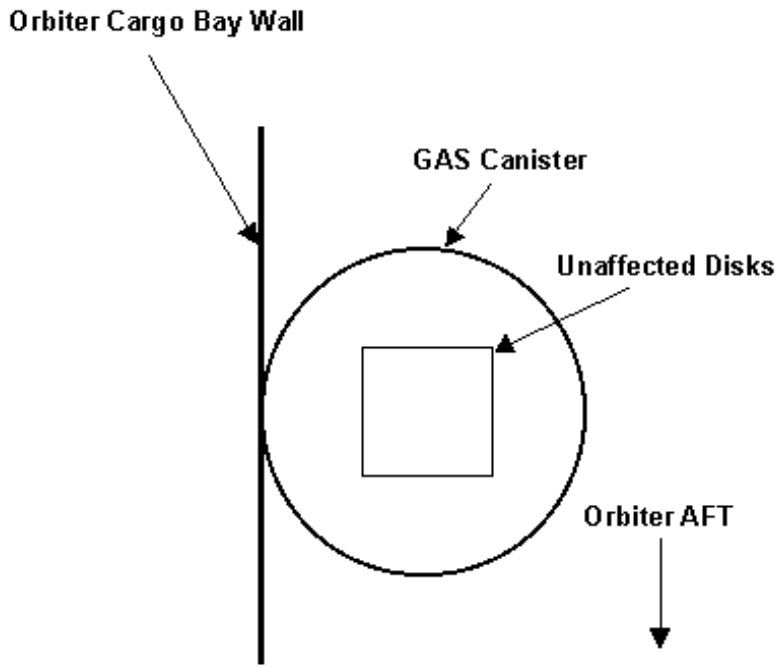
Corrupted Text File/Bitmaps



Position of SCMIT in GAS Canister STS-40



Position of SCMIT in GAS Canister STS-87



GBA with G-616 on STS-40

SCMIT On-orbit STS-97

Ready to go on STS-??? !

Additional data

For additional information please contact

Tom Hancock AverStar
256 961-4002
thomas.hancock@hsv.boeing.com
or
tom.hancock@msfc.nasa.gov